

Drycleaner Site Profiles

Butler Cleaners (#1), Jacksonville, FL

Site Description

This is an active perchloroethylene (PCE) drycleaning site that has been in operation since 1972. The adjacent property was occupied by a gasoline station from the 1920s to the 1950s. Three underground storage tanks (USTs) were removed from this site in 1992. The site is located in a residential/commercial setting.

Site Hydrogeology

Depth to groundwater: 6 ft. bgs. (unconfined aquifer)

Lithology/subsurface geology: very fine to fine-grained sand, surface-28 ft. bgs.; sandy clay, 28-34 ft. bgs.

Conductivity: 8.7 ft/day

Gradient: 0.0036 ft/ft

Groundwater Contamination

Contaminants present: PCE, trichloroethylene (TCE), cis 1,2 dichloroethylene (cis 1,2-DCE), trans 1,2-DCE, vinyl chloride (VC), toluene, ethylbenzene, xylenes, naphthalene

Highest contaminant concentrations: 17,000 µg/L (PCE), 830 µg/L (TCE), 120 µg/L (cis 1,2-DCE), 1170 µg/L (VC)

Deepest contamination: 27 ft. bgs.

Contaminant plume size: Not yet determined

DNAPLS present: Not yet determined

Soil Contamination

None reported

Description of Remediation Scenario

Technologies Used:
Chemical Oxidation

Cleanup goals:

Remediation technology or technologies used: *In Situ* Chemical Oxidation with Potassium Permanganate (KMnO₄)

Why technology or technologies used:

Final remediation scenario: The treatment area was about 10 ft. x 40 ft. x 30 ft. deep. Treatment consisted on three initial injection events of 5,000 gal. at a concentration of 7.7 g/L KMnO₄ (Carus Free Flowing grade) per injection event. The process involved nine well clusters with five monitoring/injection wells (1-in. diameter) screened at 5-10 ft., 10-15 ft., 15-20 ft., 20-25 ft., and 25-30 ft. depths. Two clusters initially were used as injection wells with other wells converted to injection wells based upon KMnO₄ and contaminant distribution. Periodic injections are ongoing.

Results

Post-pilot test monitoring indicates that, following initial injection of KMnO₄, contaminant concentrations decreased in areas of KMnO₄ distribution. However, periodic monitoring indicates that rebound of elevated PCE concentrations is occurring upon reduction of KMnO₄ concentrations within the formation. Rebound of PCE concentrations is likely due to the existence of residual DNAPL PCE that continues to act as an ongoing source of dissolved phase PCE contamination.

Costs

Site Assessment:

Design and Implementation: About \$230,000 (pilot test system) and about \$30,000 per event for quarterly monitoring and KMnO₄ injection (not including reporting costs).

O&M:

Total Costs:

Lessons Learned

1. KMnO₄ is effective for the oxidation of dissolved phase PCE contamination
2. Effective remediation of chlorinated solvent contamination using KMnO₄ may be confounded by the presence of DNAPL contamination due to mass transfer limitations of contaminant mass from the DNAPL to dissolved phase. Determination of the presence of residual DNAPL PCE is integral to the successful application of in-situ chemical oxidation technologies.

Site Specific References

Not Provided

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This profile last updated: December 7, 2001

Drycleaner Site Profiles

Butler Cleaners (#2), Jacksonville, FL

Site Description

Butler is an active PCE drycleaning facility that has been in operation since 1972. It is located in residential neighborhood adjacent to a former service station (with associated BTEX contamination) that operated from the 1920s to the 1950s. The nearest water supply well is located approximately 1800 feet northwest of the site. The contaminant source areas include: an alley adjacent to the facility where approximately 30 gallons of PCE was spilled during delivery in 1972 and where spent filters were stored; and the soils beneath the building floor slab in the vicinity of the drycleaning machine and former still location - where boil-overs occurred.

Site Hydrogeology

Depth to ground water (bgs): 6 ft bgs

Lithology/subsurface geology: Silty fine-grained sand with clay stringers, surface-31 ft bgs,

Clayey fine-grained sand to sandy clay, 31-38 ft bgs,

Clayey, fine-grained sand, 38-40 ft bgs

Conductivity (ft/day): 8.7 ft/day

Gradient (ft/ft): 0.0036 ft/ft near the facility

Groundwater Contamination

Contaminants present: PCE, TCE, cis 1,2-DCE, trans 1,2-DCE, vinyl chloride, toluene, ethylbenzene, xylenes

Highest contaminant concentrations: PCE-18,000 µg/L, TCE-830 µg/L, cis 1,2-DCE-6,800 µg/L, trans 1,2-DCE-6.0 µg/L, vinyl chloride-1,170 µg/L, toluene-21,000 µg/L, ethylbenzene-21,000 µg/L, xylenes-40,000 µg/L

Deepest significant ground-water contamination: PCE at 28-30 ft bgs

Plume size: 670 ft x 200 ft (~ 2.1 acres as defined by MCLs)

DNAPLs present: Contaminant concentrations in groundwater representing 12% of the aqueous solubility of PCE, in addition to the report of a 30 gallon PCE spill, provide strong evidence that residual DNAPL is present at the site.

Soil Contamination

Contaminants present: PCE

Highest contaminant concentrations: PCE-410 µg/kg

Description of Remediation Scenario

Technologies Used:

Cosolvent/Surfactant Flushing

Ethanol Cosolvent Flushing

Cleanup goals: Groundwater (MCL's) - PCE= 3.0 µg /L, TCE= 3.0 µg /L, cis 1,2-DCE= 70 µg/L, trans 1,2-DCE= 100 µg /L, vinyl chloride= 1.0 µg/L

Soils - Leachability-Based Levels - PCE= 30 µg/kg

Remediation technology or technologies used: Groundwater: *In situ* co-oxidation with tertiary butyl alcohol and KMnO₄

Soil: Soil Vapor Extraction (SVE)

Why was technology or technologies selected: The co-oxidation technology was expected to be advantageous over using oxidants alone because oxidation technologies are limited by the contaminant movement from the stable DNAPL phase into the aqueous phase before treatment or removal can occur. The addition of a co-solvent can increase the rate of mass transfer from the DNAPL phase to the aqueous phase by orders of magnitude. This, in turn, allows rapid oxidation of the (now-dissolved) chlorinated solvent by the oxidant solution, resulting in a significant reduction in cleanup time and costs.

Date Implemented: October 1999

Final Remediation Scenario:

An initial pilot test utilizing KMnO₄ oxidation was conducted at this site (see profile titled "Butler Cleaners #1"). Co-oxidation was implemented for the second pilot test

The contractor proposed heating the injection fluids to increase the amount of KMnO₄ available for oxidation. The solution was injected into one well at a flow rate of approximately 1 gallon per minute (gpm). Heated potable water (with and without KMnO₄) for over-flood was injected into two wells.

The contractor selected tertiary butyl alcohol (TBA) for use as a co-solvent, based on limited bench scale testing of the compatibility of TBA and KMnO₄ and the ability of TBA to act as a co-solvent for PCE under pilot test conditions. TBA has a cosolvency power of approximately 5 (vs. 3.5 for ethanol). The injection flow rate of the co-oxidant was approximately 0.5 gpm. The total amount of fluids injected in the lower zone was approximately 550 gallons of TBA and 450 gallons of water. The concentration of KMnO₄ was approximately 120 g/l water,

for a final concentration of approximately 54 g/l of KMnO₄ in the finished Co-Ox solution. A total of approximately 450 pounds of KMnO₄ was injected, which has a maximum theoretical PCE destruction capacity of about 236 pounds of PCE.

Extraction took place one week after injection completion at a flow rate of approximately 1 gpm. During the initial portion of the extraction process dynamic samples were collected hourly. After this three-day period samples were collected twice daily for the remainder of the extraction period. Within three weeks of completion of extraction, samples were collected for the usual parameters. The contractor recommends repeating this procedure quarterly for at least one year. Approximately 8,000 gallons of fluids were extracted following injection.

To accomplish remediation of the vadose zone at the site, an SVE system had been installed during the oxidation pilot test. The system used a regenerative blower to extract PCE vapor and air from 3 soil vapor extraction wells screened in the vadose zone. Vapor and air were routed through two 200-pound gas phase granular activated carbon (GAC) canisters in series. Effluent air was then discharged to the atmosphere. This pilot test also used an SVE system during the injection of heated water to minimize any potential of mobilization of chlorinated VOC vapors in the vadose zone.

Results

The SVE system was operated from October 1999 through February 2000. SVE treatment was discontinued upon confirmation that appropriate soil cleanup target levels had been met.

Evaluation of the co-oxidation pilot test is ongoing. A second application of the co-oxidation technology has been recommended.

Costs

Site assessment: \$145,000

Design and implementation:
\$156,000 (Co-oxidation pilot test)

O&M: \$25,000 (one monitoring event and report)

Total costs (only completed sites):

Lessons Learned

1. Determination of the distribution of DNAPL is critical to the design of co-oxidation injection/extraction system desiring to ensure adequate contact of co-oxidants with DNAPL.
2. The use of sodium permanganate (NaMnO₄) in liquid form may reduce handling and mixing issues experienced with the use of powdered KMnO₄.
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Site Specific References

LFR Contamination Assessment Report-2/28/98 -Revised Addendum-6/4/01
LFR Co-Oxidation Pilot Test Plan-3/30/01

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This profile last updated: December 7, 2001

Drycleaner Site Profiles

Former Quick-N-Easy Wash-O-Mat and Former Artistic Cleaners, Wichita, KS

Site Description

These two former drycleaner facilities are sources within the large multi-source Gilbert-Mosley Site in Wichita, Kansas. The neighboring inactive facilities are within a commercial area that is surrounded by residential areas. Quick-N-Easy Wash-O-Mat was a coin-operated laundry with self-service drycleaning, while the Artistic Cleaners was a standard commercial drycleaner service. The Kansas Department of Health & Environment (KDHE) conducted site investigations in 1990 and distinguished the boundaries of the contaminant plumes resulting from the drycleaners separately from the rest of the Gilbert-Mosley Site. KDHE accepted the Quick-N-Easy and Artistic sites into the State of Kansas Drycleaning Facility Release Trust Fund in 1996.

Site Hydrogeology

Depth to ground water: 15 ft bgs

Lithology/subsurface geology:

Silt and clay, 1-12 ft bgs (clays are tight)

Silty sand grading to sand/gravel, 12-40 ft bgs

Shale (bedrock), 40 ft bgs

Conductivity: 1.68 ft/day

Gradient: 0.002 ft/ft

Groundwater Contamination

Contaminants present: PCE (perchloroethylene), TCE (trichloroethylene), cis 1,2-DCE (dichloroethylene)

Highest contaminant concentrations: 1,000 µg/L (PCE), 190 µg/L (TCE), 40 µg/L (cis 1,2-DCE)

Deepest significant ground-water contamination: 25 ft bgs

Plume size: The plume is 400 ft wide and extends 2,000 ft southeast of the site. The downgradient edge of the plume "empties" into Chisholm Creek, which is a gaining stream.

DNAPLs present: Residual DNAPL anticipated

Soil Contamination

Contaminants present: PCE

Highest contaminant concentrations: 9,930 µ/kg (PCE)

Description of Remediation Scenario

Cleanup goals: Reduce PCE and degradation compound groundwater contamination to below Alternate Cleanup Levels (ACL) which are risk-based levels established by the City of Wichita. The ACLs for groundwater in Wichita's Gilbert-Mosley Site are: PCE = 14 µg/L, TCE = 21 µg/L, cis 1,2-DCE = 70. Reduce soil contamination in accordance with KDHE Risk-Based Standards: PCE & TCE = 200 µg/kg, cis 1,2-DCE = 800 mg/kg.

Technologies Used:

Chemical Oxidation

Soil Vapor Extraction (SVE)

Any other technologies used:

Why was technology or technologies selected: SVE was chosen due to the presence of buildings and utilities affecting access to the source areas. SVE is normally not a good choice for tight clays, but in this case an inefficient system is better than none at all. Permanganate injection was a new innovative technology that showed good potential so this site was chosen for a pilot test. The property surrounding the buildings was readily accessible for injection rigs and KDHE has a hazardous material storage building in the area allowing proper storage of the permanganate material.

Date Implemented: 1999 (and continue at present)

Final Remediation Design: The contractor installed a SVE system and completed two phases of sodium permanganate injections. The SVE wells targeted three "hot spots." The permanganate injection solution, known as Liquox, is a 40% liquid solution. In Phase I, the contractor diluted Liquox with water to 4%, and used direct push technology methods to inject approximately 757 gal of this solution. The contractor used three injection intervals within each of 33 probes, and injected a total of 25 gal of solution per probe. Injection time lasted 20–50 min depending on the formation intake of the solution. Sampling revealed that PCE concentrations decreased, degradation compound concentrations increased, and then PCE concentrations rebounded.

KDHE concluded that the volume and concentration of permanganate was insufficient in Phase I. The contractor then diluted Liquox with water to 15% for Phase II, and injected a total of 1,472 gal. Phase II included six vertical injection intervals within each of 64 probes. The contractor injected approximately 23 gal of solution in each probe.

Results

The permanganate injections have not significantly reduced PCE concentrations. PCE concentrations rebounded or remained the same shortly after both injection phases. The residual DNAPL in the soil appears to inhibit the success of the injection solutions. The source has not been sufficiently removed and continues to serve as a source for groundwater contamination. KDHE has concluded that permanganate desorbed residual DNAPL PCE off of the soil particles and caused it to dissolve in the groundwater causing an initial increase in concentrations. Once the permanganate was completely used, the remaining PCE likely resorbed to the soil particles or remained mobile. Therefore, KDHE believes that insufficient quantities of Liquox may limit the success of the treatment. Natural factors, such as iron and microorganisms, also compete for the permanganate and decrease the quantity available to treat the contaminants.

SVE appears to be effective, but relatively tight clays prevent a large radius of influence around the SVE wells. SVE has no impact on the permanganate injections. KDHE has continued to evaluate sampling events, and will use these results to determine the next cleanup steps. The most recent sampling event revealed PCE concentrations up to 530 µg/L, TCE concentrations up to 85 µg/L, and cis-1,2-DCE concentrations up to 30 µg/L.

Costs

Site assessment: \$23,033

Design and implementation: \$105,718

O&M: \$61,928

Total costs (only completed sites):

Lessons Learned

1. It is absolutely essential to remove the source prior to permanganate treatment events. Once the permanganate solution was used up, the source continued to release PCE. The volume and concentration of Liquox, therefore, was insufficient to treat the contamination. Substantially increased volumes may cause the technology to be cost prohibitive with limited budgets.
2. The sodium permanganate injection pilot study provided enhanced groundwater monitoring, therefore the O&M costs with this site are higher than normal.
3. KDHE also identified difficulty associated with injection process. Although the contractors were able to use standard probe rod diameters, there was nothing to prevent upward movement along the sides of the rod. This posed occasional problems. KDHE has requested the contractor to provide better injection method to seal the annulus space around the probe rods.
4. Sodium, manganese, and chloride levels were elevated following the sodium permanganate injections. Some levels initially exceeded allowable levels, but quickly reduced to acceptable levels.
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Site Specific References

Not Provided

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Drycleaner Site Profiles

Hanner's Cleaners, Pompano Beach, FL

Site Description

This is an inactive PCE drycleaning site that operated from the early 1960's to 1989. No. 2 fuel oil (boiler fuel) contamination from leaking USTs is also present. The former facility has been razed. The contaminant source areas are the former location of a distillation unit and the former UST locations. The nearest water supply wells are located 1500 to 2000 feet northeast of the site.

Site Hydrogeology

Depth to ground water (bgs): 6 ft bgs

Lithology/subsurface geology: Fine to medium-grained quartz sand with limestone stringers, surface - 46 ft bgs;

Fine to medium-grained sand, 46 - 62 ft bgs;

Coquina 62 - 68 ft bgs;

Fine-grained sand & sandstone with limestone stringers, 68 - 84 ft bgs

Conductivity (ft/day): 92 ft/day

Gradient (ft/ft): 0.0007 ft/ft

Groundwater Contamination

Contaminants present: PCE, TCE, cis 1,2-DCE, trans 1,2-DCE, 1,1-DCE, vinyl chloride

Highest contaminant concentrations: PCE-42,000 µg/L, TCE-12,000 µg/L, cis 1,2-DCE-170,000 µg/L, trans 1,2-DCE-260 µg/L, 1,1-DCE-89 µg/L, vinyl chloride-59,000 µg/L

Deepest significant ground-water contamination: cis 1,2-DCE (39.5 µg/L), Vinyl chloride (13.6 µg/L) at 75 ft bgs

Plume size: 1,350 ft x 1000 ft (defined to MCLs)

DNAPLs present: Likely (groundwater PCE concentrations are 28% of the aqueous solubility)

Soil Contamination

Contaminants present: PCE, TCE, cis-1,2-DCE, TPH (No. 2 fuel oil)

Highest contaminant concentrations: PCE-37.2 mg/kg, TCE-3.32 mg/kg, cis-1,2-

DCE-1.22 mg/kg
TPH-4667 mg/kg

Description of Remediation Scenario

Technologies Used:

Chemical Oxidation

Soil Vapor Extraction (SVE)

Cleanup goals: Groundwater - MCLs: PCE = 3.0 mg/L, TCE = 3.0 mg/L, cis-1,2-DCE = 70 mg/L, trans-1,2-DCE = 100 mg/L, vinyl chloride = 1.0 mg/L. Soils - leachability levels - PCE = 30 mg/kg, TCE = 30 mg/kg, cis-1,2-DCE = 400 mg/kg, TPH=340 mg/kg

Remediation technology or technologies used: Groundwater: *In situ* chemical oxidation with hydrogen peroxide (pilot test) ;

Soil: Excavation and Soil Vapor Extraction (SVE)

Why was technology or technologies selected: Contaminant concentrations indicative of DNAPL are present in groundwater in permeable sediments. The source area was well delineated and substantial and apparently ongoing off-site migration of the plume was occurring.

Date Implemented: 2000

Final Remediation Scenario:

Treatment Area: 2,100 ft² (52,500 ft³) - upper Biscayne aquifer

Quantity: Catalyst Oxidizer

2,640 gallons 5,280 gallons

3,000 gallons 7,700 gallons

Concentration: 12% Hydrogen Peroxide

Injection Wells: Six 4-inch diameter on 15 ft centers

Screen Depths: 6-12 ft bgs, 14-20 ft bgs, and 22-30 ft bgs (2 ft bentonite seals between screened intervals)

Radius of influence: ~10 ft (per well)

Avg. Injection Rate: Catalyst Oxidizer

Injection 1 5.44 gpm 3.98 gpm

Injection 2 5.08 gpm 3.23 gpm

Baseline sampling was conducted (6/19/00). Follow-up sampling was conducted following a second injection event (8/1/00), and 9/12/00.

Results

Subsequent to the pilot test, TCE and PCE exhibited the best overall reduction, while VC exhibited the poorest. Possible explanations for this are that the oxidation rate for VC may be slower, and the oxidation of PCE and TCE may be incomplete, resulting in the formation of VC. Results for the baseline and three post-injection sampling events are as follows:

	6/19/00	8/1/00	9/12/00
PCE	19,397	4,498	1,090
TCE	9,025	4,002	339
Cis 1,2-DCE	212,089	117,900	71,760
Trans 1,2-DCE	2,234	734	626
Vinyl chloride	14,244	33,382	14,771
Other VOHs	108	256	84
Total VOHs	257,097	160,772	88,670

Percentage Mass Reduction (after 90 days): PCE-95%, TCE-97%, cis 1,2-DCE-62%, trans 1,2-DCE-78%, 1,1-DCE-50%, Vinyl Chloride-16%

Soil remediation included limited excavation and installation and operation of a soil vapor extraction system - April 2001. Full scale hydrogen peroxide injection occurred in April, 2001 and October of 2001. Results are forthcoming.

Costs

Site assessment: \$199,000

Design and implementation:

\$17,000 (Design)

\$150,415 (Pilot Test Overall Project)

O&M:

Total costs (only completed sites): \$366,415

Lessons Learned

1. Underground Injection Control (UIC) variance may be required.
2. Thorough assessment and delineation of the contaminant source area and identification of site stratigraphy to identify features that control contaminant distribution and oxidant movement is critical to successful remediation. Segmented injection wells (alternating sand and bentonite at specific intervals) were employed along with a K-packer-equipped injector assembly to apply injections at distinct depth intervals within individual wells. This approach

allowed cost savings on injection well installation, and appeared to facilitate the targeting of injections at specific depth intervals.

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Site Specific References

1. Fenton-based Remediation of a Chlorinated Solvent Groundwater Plume Using Segmented Injection Wells - a Field Study- Heijn, Kakarla, Hartsfield, Koenig-6/01
2. Metcalf & Eddy Contamination Assessment Report-2/11/98
3. Metcalf & Eddy Chemical Oxidation Pilot Test Results-10/20/00

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This profile last updated: December 10, 2001

Drycleaner Site Profiles

Paul's Classic Drycleaners, --, WI

Site Description

Paul's Classic Cleaners is an active facility that has operated in a commercial setting since the 1980s. Investigations revealed the presence of chlorinated compounds in the soil and groundwater. Contamination had migrated off-site, but did not impact drinking water wells. The most likely source of contamination appears to be the disposal of solvent wastes into the sewer system. The exact quantity of perchloroethylene (PCE) released is unknown. The underlying statutory authority for the cleanup is Chapter 292 of the Wisconsin Statutes, also known as the "Spill Law." The investigation and remediation activity at the site have qualified for financial reimbursement through the Wisconsin Drycleaner Environmental Response Program.

Site Hydrogeology

Depth to ground water: 8.5-10.5 ft. bgs.

Lithology/subsurface geology: Fill material, grade-2 ft. bgs.
Interbedded clay, silt, and sand, 2-10 ft. bgs.
Clean sand, 10-18 ft. bgs.
Fluvial sand, 18-35 ft. and deeper bgs.
Bedrock is comprised of sandstone.

Conductivity: 0.28 ft/day (fill material) to 8.5 ft/day (fluvial sand)

Gradient: About 0.002 ft/ft

Groundwater Contamination

Contaminants present: PCE, trichloroethylene (TCE), cis-1,2 dichloroethylene (cis-1,2-DCE), trans-1,2-DCE, vinyl chloride (VC)

Highest contaminant concentrations: 27,000 µg/L (PCE), 2,300 µg/L (TCE), 5,400 µg/L (cis-1,2-DCE), 74 µg/L (trans-1,2-DCE), 120 µg/L (VC)

Deepest significant ground-water contamination: About 75 ft. bgs.

Plume size: About 100 ft. downgradient.

DNAPLs present: Although contractors have not identified free phase product in groundwater, the high quantity of solvent product that migrated into the groundwater and the evidence of a downward gradient are possible indications of DNAPL.

Soil Contamination

Contaminants present: PCE, TCE

Highest contaminant concentrations: 5,600 µg/kg (PCE), 134 µg/kg (TCE)

Description of Remediation Scenario

Technologies Used:

Air Sparging
Bioremediation
Multi-phase Extraction
Ozone Air Sparge
Pump and Treat
Soil Vapor Extraction (SVE)

Cleanup goals: The ultimate cleanup goal is to reduce contaminant concentrations to the groundwater quality standards established in the Wisconsin Administrative Code, NR 140. The enforcement standard for PCE is 5 µg/L. Remediation activities should remove the contaminant source, stabilize plume migration, and minimize long term threats posed to human health and the environment.

Remediation technology or technologies used: Enhanced Bioremediation Using Ozone and (pilot study) Soil Vapor Extraction (soil); Air Sparging Using Ozone (pilot study) and Multi-Phase Extraction (groundwater)

Why technology or technologies selected: The high water levels at the site limit the usefulness of Soil Vapor Extraction. Therefore, contractors also selected multi-phase extraction with treatment of extracted groundwater by air stripping as the most cost effective remedial approach for the site.

Final remediation design: Contractors conducted an ozone injection test using the C-Sparge process. This process includes sequential sparging and groundwater recirculation functions performed below and above each other, respectively, in the sparge well. The C-Sparger unit was programmed to deliver an air/ozone gas mixture (at 1.7-2.2 cfm) to the lower sparge point, then the in-well sparge point, and power for the in-well pump operation, on a repeating cycle over a period of 16-18 hours/day.

The Multi-phase Extraction system uses high vacuum to simultaneously extract vapors, contaminated groundwater, and free-phase liquids from the subsurface vadose zone and aquifer. Groundwater and extracted product are then treated through an air stripper and a diffused aeration tank.

Results

Ozone Air Sparge: Ozone injection system effectively transmitted ozone into the aquifer with a radius of influence of about 50 ft. for an injection well. VOC

concentrations did not decrease during the short-term ozone injection test.

MPX: Results not yet available as the system has not yet been implemented.

Costs

Site assessment: \$16,507.24 (soil); \$66,028.89 (groundwater)

Design and implementation: \$2,373.44 (soil); \$43,882.25, including cost of ozone sparge pilot study (groundwater)

O&M: Expect 5 years of operation and maintenance, followed by one year of natural attenuation monitoring. Estimate costs are \$356,500.00.

Total costs:

Lessons Learned

1. While the ozone sparge technology was effective in treating the chlorinated solvents, the presence of free phase product required enhancing the ozone sparge system and resulted in increased time to remediate the site. Both the treatment enhancements and extended treatment time made the ozone sparge treatment technology cost prohibitive.
2. With regard to the MPX system, it is uncertain whether the vacuum extraction wells will have the ability to create a drawdown of groundwater great enough to extract chlorinated solvent compounds found at greater depths within the bedrock aquifer.
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Site Specific References

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Contacts

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This profile last updated: November 26, 2001

Drycleaner Site Profiles

Swift Cleaners, Jacksonville, FL

Site Description

This is an active PCE drycleaning facility has been operating since 1971. The site is located in a commercial/residential setting. The nearest water supply well is located approximately 0.25 mile south-southwest of the site. The contaminant source areas are outside the service door where spent filters were stored, the soils beneath the building floor slab around the drycleaning machine and a former sanitary sewer line leak.

Site Hydrogeology

Depth to ground water (bgs): 3-14 ft bgs

Lithology/subsurface geology: Silty, very fine to fine-grained sands, surface-45 ft bgs;

Clayey, very fine-grained sand with clayey sand lenses 45-65 ft bgs;

Limestone interbedded with clay 65-80 ft bgs

Conductivity (ft/day): 12-15 ft/day (surficial sands)

Gradient (ft/ft): 0.0043 ft/ft (surficial sands)

Groundwater Contamination

Contaminants present: PCE, TCE

Highest contaminant concentrations: PCE-10,000 µg/L, TCE-24 µg/L

Deepest significant ground-water contamination: PCE at 50 feet bgs

Plume size: 300 ft x 1000 ft

DNAPLs present: A PCE concentration of 10,000 µg/L represents approximately 6.7% of

the aqueous solubility of PCE indicating that residual DNAPL may be present.

Soil Contamination

Contaminants present: PCE

Highest contaminant concentrations: PCE-40 mg/kg

Description of Remediation Scenario

Technologies Used:

Chemical Oxidation

Soil Vapor Extraction (SVE)

Cleanup goals: Groundwater - MCLs: PCE= 3.0 µg /L, TCE= 3.0 µg /L

Soils - leachability-based Soil CTL: PCE= 30 µg/kg

Remediation technology or technologies used: Groundwater: in-situ chemical oxidation using hydrogen peroxide;

Soil: Soil Vapor Extraction (SVE)

Why was technology or technologies selected: Soil vapor extraction is a cost-effective technology to remove VOCs from unsaturated permeable sediments. *In situ* chemical oxidation was selected because of the high contaminant concentrations, active migration of contaminants off-site, and the high aquifer permeability.

Date Implemented: 1999 (pilot); 2000

Final Remediation Scenario: A pilot test was conducted within the source area in July, 1999.

Treatment Area: 2,500 ft²

Quantity (per injection):

Catalyst Oxidizer

200-400 gal 300-800 gal

Concentration: 25% Hydrogen Peroxide- Reduced to 12.5% in the shallow wells for the 2nd and 3rd injections.

Wells: 6 clusters (2 wells each), Screen Depth: 30-45 ft

Injections: 3 in all but 1 cluster, which had 2,

Radius of influence: 7.5 feet

Avg. Injection Rate: 7 gpm (initial injection), 3.5 gpm in (subsequent injections)

Full-scale groundwater remediation will consist of: 1) in-situ chemical oxidation with hydrogen peroxide for the contaminant source area and the plume above Natural Attenuation Default Source Concentrations (NADSC) (e.g. 300 µg /L PCE); and 2) monitored natural attenuation for the plume below NADSC's.

Remediation design includes 4 phases. Phase I focused on two areas, IA and IB. Two of the three planned injections, have been completed for these areas. Initial injection was in December, 2000. Below are specifications:

Phase I-Area IA:

Treatment Area: 2,500 ft² (pilot test area)

Quantity (per injection):

Catalyst Oxidizer

Injection 1 400 gallons 600 gallons

Injection 2 400 gallons 600 gallons

Injection 3

(Planned) 300-500 gallons 500 gallons
Concentration: Injections 1& 2- 15% Hydrogen Peroxide
Wells: 7 new, Screen Depth: 35 to 45 ft,
Injections (per well): 3,
Radius of influence: 7.5 feet
Avg. Injection Rate:
Injection 1- 6 gpm
Injection 2- 4 gpm

Phase I-Area IB:

Treatment Area: 2,000 ft² (downgradient of IA)
Quantity (per injection):
Catalyst Oxidizer
Injection 1 400 gallons 600 gallons
Injection 2 400 gallons 400 gallons
Concentration: Injection 1 -14% Hydrogen Peroxide; Injection 2 -15% Hydrogen Peroxide
Wells: 13 new, Screen Depth: 35-45 ft
Injections (per well): 3
Radius of influence: 7.5 feet,
Avg. Injection Rate:
Injection 1- 5 gpm
Injection 2- 4 gpm

The SVE system for full-scale soil remediation consists of five 12-ft vapor extraction wells. The design radius of influence is 15 ft with a design flow rate of 27 cfm. System startup was in December, 2000.

Results

Chemical oxidation results were mixed initially, with concentrations decreasing in some areas and increasing significantly in a few areas. Based on sustained rebound in some portions of the 38- and 43-ft intervals, the majority of the saturated zone source mass was determined to be between 35 and 45 ft bgs (the base of the surficial sands). PCE concentrations have been reduced to below NADSCs in both Phase IA and IB areas. The average contaminant reductions in Phase IA and IB monitoring well samples were 70-98 percent.

Injections in areas IA and IB are complete. Subsequent remediation efforts will be conducted in three additional phases (II through IV) as necessary.

Costs

Site assessment: \$ 164,000

Design and implementation: \$110,000 (pilot test);
\$118,000 (full-scale/soil)
\$207,000 (full-scale/groundwater)

O&M: \$12,000 (soil)
\$23,000 (groundwater)

Total costs (only completed sites):

Lessons Learned

1. Recommend complete delineation of underground utilities prior to injection activities. Use of geophysical survey (GPR and electrical methods) is very useful to ensure that underground utilities are not encountered during direct push operations.
2. Inform all property owners concerning the extent of injection activities and coordinate with site property owners to ensure uninterrupted access to the property.
3. Ensure all wells around the injection well are tightly capped prior to H₂O₂ injection
- 4.
- 5.
- 6.
- 7.
- 8.

Site Specific References

1. HLA Contamination Assessment Report-12/97-Addendum-10/98
2. ARG, Inc. Oxy-Cat Pilot Test Summary Report-5/00
3. HLA SVE System Startup Report-6/11/01
4. HLA Remedial Action Plan-7/00 -Modification-3/01
5. Harding ESE Chemical Oxidation Injection Data Report-6/1/01 and 6/21/01

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